	NORTH CAROLINA DEPARTMENT OF LABOR	No. 22-6
	OSH DIVISION	Date: 10/2009
	OSHNC INDUSTRIAL DATA REPORT	Pages: 5

Industry: **Textile Mill Fabrics**	Sub-Group: **Non Woven Fabrics**
SIC: **2297**	NAICS: **313230**

DEFINITION: Non woven fabrics are produced by bonding or interlocking fibers or both. This is accomplished by mechanical, chemical, thermal or solvent means or by a combination of these means. The term does not include fabrics which are woven, knitted, tufted or made by wool felting process.

PROCESS DESCRIPTION:

1. There are numerous variations in processing and producing the non-woven product. The raw stock received in bales or cartons is generally cotton, rayon, blends, acetate, nylon or other synthetic fibers and processed to form the basic web structure of the product. Normally, this is accomplished first through opening/picking in order to loosen, separate and remove dirt and foreign material from the stock. The stock is then carded or garnetted to produce a web in which the fibers are arranged linearly. The web may then be bonded in this condition or subsequently cross lapped in order to gain additional strength. The initial web may also be formed in a device identified as a Rando-Webber. In this procedure the fibers are blown into an air chamber where they are deposited onto a doffer roll in a random fashion. This produces a web with equally distributed strength. Following web formation the material is transported for further processing on a floor apron and through a calendar roll for compressing. Specifically, non-wovens will normally be processed by dry lay, wet lay or spun bonded. The dry lay process is the most common. However, technological advances indicate that wet lay and spun bonded processes will continue to grow at a faster rate.
2. Dry laid webs use staple length fibers processed through one of the following techniques:
    a) Carded Web – Parallel Laid. Fibers are produced through a series of opening and blending steps to provide a suitable feed to the web forming process. Cards or garnett machinery are used to form the web. Since a web doffed from a single card is relatively light in weight, there may be a series of units combined in tandem to produce thicker webs. Typically, the doffed web from one card is laid upon a moving belt operation where heated rolls, chemical binders or other techniques are employed to bond the web weight. The web structures are carried on the belt conveyor to the web bonding where they are pringed or saturated with adhesives. Successive steps include calendaring, embossing or aperturing, inspection, slitting to the desired widths and through windup.
    b) Carded Web – Cross Lapped. This process also follows the typical opening and blending phase. Cards and garnetts are utilized in this process in much the same way as in "Parallel Laid" process. In contrast, the webs doffed from each card are transported to a cross lapper where they are laid down on a moving belt in a lapped fashion running perpendicular to the direction of the card feed. This web is then transported to the web bending where it may undergo needling (mechanically bonded using stitch-bonding machines), thermal bonding (utilizing heat to melt special fibers that were blended into the web) or adhesive bonding (using spray or saturation methods). If an adhesive is used, the web is processed through calendars which are normally preset to high temperatures. This phase enables the adhesive agent to become softened and saturate the fibers and also to press the adhesive into the fabric. The product may then be processed through an air cooling system onto a slitter, inspected and onto a windup.
    c) Random Laid Web Process. The most common system within this process utilizes fiber stock-fed by an air stream to isolate individual fibers. A second air stream blends the fibers in a

vortex, and a third air stream carries the mass of fiber onto a moving screen where they condense to form the random web. Several variations of this approach have been developed e.g., Rando-Feeder and Rando-Webber Machines, Pneumatic equipment and others. The stock is open, blended and bonded either by wet or dry methods as in the other processes.

3. Sun Laced Process. The opening, blending and separation into individual fibers is accomplished by a controlled air stream. Fibers are condensed in a random manner onto a moving screen or cylinder and then conveyed into high velocity streams of water causing movement of the fibers corresponding to the pattern of the screen. The fabric is removed, dried, slit to desired width and taken up in roll form. Further treatments, common to the other processes, such as needling and chemical bonding, are not required. However, treatments commonly used in processing of woven or knitted textiles, i.e., finishing, heat setting, stretching, printing, embossed, calendaring, etc., may be used to provide the final product.
4. Spun Bonded Web Process. The web structures are composed of randomly oriented continuous filament fibers bonded at cross-over points. The web formation and bonding are accomplished on a continuous and integrated basis. Multiple spinnerettes extrude large numbers of filaments which are drawn and oriented by rolls or high velocity air streams. The filament bundles are projected at high speeds in programmed array onto a slow moving belt provided with suction to hold down the filaments. Dispersion of these bundles is accomplished by air streams, electrical charges or other means. The belt carries the web to a bonding operation where heated rolls, chemical binders or other techniques are employed to bond the web. Thermal bonds can be used for self binding of multiple polymers. Various alternating processes consisting of steaming and calendaring can be employed. Inspection, slitting and windup are included. The entire process can be automatically controlled.
5. Wet Laid Web Process. Fiber suspension is formed using water as a vehicle. Longer and stronger fibers are used. This process is found in paper manufacturing. The process usually includes: missing, grinding and dilution of fibers to form the slurry; and condensing the fibers into a drum or inclined wire; de-watering by suction or squeezing; drying and curing; and bonding using either spray or paint process; slitting and wind-up.
6. Stitch Bonding Process. The Mali and Arachne systems are the two most common stitch bonding processes, each having variations in equipment or technique so that different types of non-wovens are produced. Fabrics can be formed entirely from yarns, by a combination of yarns and a non-woven batting or entirely by a non-woven batting. The lap is prepared as in previous processes through carding or garnets, then folded and deposited in a transverse direction into a stitching process. The Arachne system utilizes a single or double bar warp knitting machine with special hollow needles. The principal working elements are these needles plus locking sinkers or knock over sinkers, each having its own drive mechanism. The fabrics may be dyed, printed or treated on normal finishing equipment. The basis of this process however is the 'nitted-through' method of non-woven fabric. The Mali technique also utilizes the high speed sewing machines to prepare, in sheet form, the weft threads and connect them to warp threads. Generally, the process includes filling yarns fed in from creels, warp yarns fed in from beams are laid on top of the filling yarns and dewing yarns from another beam complete the fabric structure with a variety of stitches.

Binders for Non Wovens

Bonding these non-woven fabrics offers a variety of procedures. Among these many variations are the

following:

Fiber bonding: Thermoplastic or two-stage fiber binders are mixed with the body fibers at the start of the process and fused or cured to hold the entire product together.

Powder Bonding: Dry thermoplastic or thermosetting resins, in powder form, are mixed with the body fibers at the start of the process and/or added to the web at the intermediate point in the process. During subsequent curing, the resins are cured or fused to hold the entire product together.

Spray Bonding: Thermoplastic or two-stage resins in emulsion or solution form are sprayed on the web at an intermediate point during the process. These resins are then cured or fused.

Saturation or Wet Bonding: The web, once formed, passes through a bath of thermoplastic or thermosetting resins (either solution or emulsion form) and then into a curing range or fusing or curing.

Mechanical Bonding: The completed web is mechanically compacted, tangled and interlocked to provide the bond of sufficient strength to hold the product together with further curing or fission.

Combination Bonding: A combination of two or more bonding methods combined into a single process.

Hazards Analysis

Major Hazards			Other Hazards		
Location	**Item**	**Hazard**	**Location**	**Item**	**Hazard**
Opening, picking and carding	Cotton dust	Byssinosis	Adhesive drug room and bonding area	Piping and machinery	Scalds, burns, hot liquids, tanks and dragging process
Opening, picking, blending and carding	Point-of-operation i.e., linkerins, doffers, beaters, feeders, cylinders Noise	Amputations and crushed limbs Hearing loss	Bonding and drying	Unguarded steam pipes	Burns
Warehouse	Bales of cotton, synthetics	Fall potential (400 to 800 lb. bales)	Adhesive drug room and bonding area	Caustics	Skin burns and inhalation of caustics
Throughout	Mechanical power transmission apparatus	Amputations and crushed limbs	Inspection wind-up	In-running nip points of wind-up machinery	Broken limbs, amputations and lacerations

Opening room	Removing metal bands on bales Cotton dust	Eye and face lacerations Byssinosis	Opening, picking, carding and garnetting	Flyings and lint	Fire hazard
Adhesive drug room	Bonding agents and activators such as polyvinyl chloride, trichloroethylene, butadiene, acrylonitrile, zinc oxide, magnesium oxide, calcium oxide, carbon black, petroleum naphtha, toluene, acetone, oxaylic acid, thermoplastic resin, dimethyl sulphate and dioetyl phthalate	Chemical exposure, skin and eye irritation and harmful effects to body organs and systems	Drug room, flammable liquids, vapors	Potential explosion and fire	Chemical exposure
			Shipping and receiving	Forklifts Dockplates	Carbon monoxide and accidents Overturned forklifts

Key OSHNC Standards

Reference	29 CFR 1910 — General Industry Standards
ANSI-B30.6	Overhead underhung hoists
NCGS 95-129	General duty clause - ergonomics
Subpart E	Exit Routes, Emergency Action Plans, and Fire Prevention Plans
Subpart I	Personal protective equipment
Subpart O	Machinery and machine guarding (where 1910.262 does not apply)
Subpart S	Electrical
1910.95	Occupational noise exposure
1910.141	Sanitation
1910.147	Control of hazardous energy (lockout/tagout)

1910.176	Handling materials – general requirements
1910.178	Powered industrial trucks
1910.262	Textile machinery
1910.1000	Air contaminants
1910.1017	Vinyl chloride
1910.1043	Cotton dust
1910.1045	Acrylonitrile
1910.1048	Formaldehyde
1910.1051	1,3 - Butadiene
1910.1200	Hazard communication

Inspection Analysis

The inspection should begin in the receiving area and warehouse. Check powered industrial trucks, walking/working surfaces and stacking. Then opening, carding, garneting, blending and picking must be closely checked for properly guarded machinery, power transmission equipment, points of operation, rotating parts, and lockout and tagging procedures. Exposure to cotton dust must be evaluated. The method bonding must be examined and will require an inspection in the drug room where the bonding agents are stored and handled. These agents must be evaluated for explosion or flammable material hazards. Industrial hygienists must evaluate the possible toxic effects of bonding agents. Calenders must be inspected for the hazard of ingoing nip points. Ovens and driers must be evaluated for lockout procedures, exposed steam pipes and point of operation hazards. Wind-up and inspection departments present nip point hazards. Check the shipping department for material handling hazards. Electrical equipment must be properly grounded and approved for its location.

Other Pertinent Comments: Inspectors should be alert for the possible use of hydrochloric acid and formaldehyde. This mixture is used when processing fabrics for “No Iron, Wrinkle Free.”